



Cleaning and Degreasing P2 Fact Sheet

Utah Department of Environmental Quality

Promoting a Healthy Environment

Introduction

Cleaning and degreasing of metal parts is most often done to remove soils that interfere with the operation or performance of equipment, or to prepare equipment for subsequent procedures such as painting, plating, or coating. Cleaning and degreasing is also carried out for purely cosmetic reasons to remove soils which cause an undesirable appearance.

Common Methods of Cleaning and Degreasing Metal Parts

Cold cleaning is generally performed in a tank of cleaner at room temperature. Usually, the items to be cleaned are agitated mechanically or ultrasonically. A varsol dip tank is an example of a cold cleaning system.

Wipe cleaning or spot cleaning refers to localized cleaning of a work piece. Typically, a lint-free cloth saturated with cleaners is used to manually clean the part. When the cleaning operation has been completed, the excess cleaner is left to evaporate from the work piece.

Vapor degreasing uses a partially full container of cleaner heated to its boiling point. The parts to be cleaned are suspended in the vapor cloud above the boiling liquid. The vapor condenses on the cooler parts, dissolves the contaminants and flushes the liquid mixture back into the hot liquid. When the cleaning process is complete, the parts are removed from the tank and they quickly dry in the air.

Why Changes Are Needed

Traditionally, chlorinated and halogenated hydrocarbons, mineral spirits, and petroleum distillates have been used as cleaners and degreasers. These products are recognized for their high cleaning, fast drying performance. However, a number of commonly used solvents are **ozone depleting substances**. The use of many of these solvents is restricted or banned.

Other common solvents contribute to the creation of low level ozone, a component of smog produced when the volatile organic compounds (VOC's) in the solvents evaporate into the atmosphere.

Many solvents are highly toxic to humans and wildlife. They may have chronic or acute effects, and some are carcinogens or teratogenic. The human health risk can be quite pronounced as workers are often in close contact with solvents for extended periods of time. Without proper safety equipment or ventilation, airborne concentrations of solvent vapor can easily reach dangerous levels, not just for workers, but for others in the same building.

Avoid or Reduce

Avoiding the use of cleaners or degreasers is always the most environmentally responsible option. Before spending time and effort looking for alternatives, step back and take a good look at why you are using harmful cleaners or degreasers in the first place. Ask yourself if there are any steps your organization can take to eliminate or, at least, reduce the use of these harmful substances. For example:

- Attempt, as much as possible, to eliminate or reduce cleaning operations.
- Try to find an alternative to the actual cleaning process using either a new technology or a new solvent.
- Finally, if no alternatives are applicable, some changes can be made to the existing cleaning and degreasing equipment.

To improve solution efficiency in the cold cleaning process, a “closed loop” system, including a filter and an oil skimmer, should be installed. Such a system will extend the life of the solution and at the same time decrease the amount of solution to be disposed of.

To reduce air emissions in the vapor cleaning process, the following add-on controls should be taken into consideration:

- Slowing down the rate of entry or removal of the work load from the vapor degreaser.
- Improving the rack design to ease the part’s drainage.
- Increasing the freeboard height of the tank.
- Adding refrigerated coils on the freeboard.
- Installing simple flat or rolling covers.

Alternatives to Solvents

It is often very difficult to completely eliminate the need for cleaning or degreasing operations. Fortunately, a wide range of alternatives are available. The following is a description of different options that are presently available.

- **Aqueous Cleaners** are mixtures of water, detergents, surfactants, emulsifiers and other additives that promote the removal of organic and inorganic contaminants from hard surfaces. They can be used to remove light oils and residues left by other cleaning processes, as well as to remove heavy oils, greases and waxes. When using aqueous cleaners, rinsing and drying may be required. To prevent corrosion, a rust inhibitor will have to be added to the cleaner or to the rinse water.
- **Enzyme Cleaners** are a particular group of aqueous cleaners. Enzymes are mixed with warm water and can be used in any process that uses aqueous or semi-aqueous cleaners. Their principal advantage is that after use, if they have not been contaminated with hazardous products, they can be disposed directly in the sewer system.
- **Semi-Aqueous Cleaners** are comprised of a group of cleaning solutions composed of natural or synthetic organic solvents, surfactants, rust inhibitors and other additives. They include terpene, esters, glycol ethers, and *N*-methyl-2-pyrrolidine (NMP). The term semi- aqueous refers to the use of water in some part of the cleaning process, such as washing, rinsing, or both. In general, they have a good ability to remove heavy grease, waxes and tar. Their low surface tension allows them to penetrate small spaces. Some also have low vapor pressure and thus have low volatile organic compound (VOC) emissions. Depending on the type of cleaner, adverse effects will vary; some may be toxic to aquatic life, others are highly flammable or need rinsing and drying.

- **Non-Halogenated Solvent Cleaners** including petroleum solvents, alcohols and ketones are effective in removing resin oils and greases. The electronics industry often uses alcohol for defluxing operations. Petroleum solvents are compatible with most plastics, metals and rubbers. These and other solvents are useful in wipe-cleaning and cold immersion processes. The solvents dissolve contaminants on the surface of the parts. In some cases ultrasonics, high (or low) pressure sprays, or mechanical agitation is necessary to achieve required cleanliness. Ketones have a low flash point and therefore are not used in spraying processes. If a spot free finish is desired, then parts may have to be dried in an additional process.

New Technologies

- **Completely Enclosed Vapor Cleaner (CEVC)** is an alternative to the conventional vapor degreaser. In CEVC, the work load is placed in an air tight chamber into which solvent vapors are introduced. After cleaning is complete, the vapors are evacuated and captured. Using that process, solvent air emissions are virtually eliminated. No significant changes are required in the operator routine, but each batch will take more time to be cleaned. The operating cost will be reduced due to the significant recovery of solvent, however the initial capital cost and the energy requirements are relatively high.
- **Automated Aqueous Cleaning and Aqueous Power Washing** are two new systems that replace cold cleaning and vapor degreasing processes. They both eliminate solvent hazards by using an aqueous or semi-aqueous cleaner. They are easy to install and operate but require wastewater treatment. **Automated Aqueous Cleaning** system is used to clean small parts like the ones usually cleaned by the vapor degreasing process. The washer sprays an aqueous or semi-aqueous solution across the parts to remove oil and debris. The parts travel through a series of chambers, each with different concentrations of cleaning and rinsing solutions. Excess sprayed solution is recovered and reused. Because water and cleaning solutions can be reused, the operation of an automated aqueous cleaning system will reduce water and soap consumption. **Aqueous Power Washing** systems are being used in a variety of industries to clean large parts. The parts to be washed are placed on a turntable inside a power washer unit. As the turntable rotates, the parts are sprayed from all angles with water at high pressure and elevated temperature. Aqueous power washing systems provide more efficient cleaning compared to manual tank cleaning, and cleaning times are reduced. When combined with an oil skimmer and a filter, the aqueous power washing unit will significantly reduce water and soap consumption.
- **Ultrasonic Cleaning** applies high frequency sound waves to the liquid cleaning solution. The sound waves generate zones of high and low pressure throughout the liquid. In the zones of negative pressure, the boiling point decreases and microscopic bubbles are formed. As the sound waves move, this same zone becomes positively pressured, thereby causing the bubbles to implode. This is called cavitation and is the basis of ultrasonic cleaning. Cavitation exerts enormous local pressure and temperature on parts. When using this method, parts with small crevices can be cleaned more easily to meet cleaning standards. By making aqueous cleaners more effective, ultrasonic cleaning eliminates the need for strong solvents. The problems associated with ultrasonic cleaning are the parts to be cleaned must be immersible. Thick oils and greases may absorb ultrasonic energy and may not be removed. Testing must also be done to obtain optimum solution and cavitation levels for each operation.
- In the electronics industry, cleaning flux after soldering might be a problem. The use of **Low-Solid Fluxes** will eliminate the need for cleaning, and **Inert Atmosphere Soldering** totally eliminates the need for flux. These two new technologies will eliminate solvent use.

- In the avionic industry, solvent stripping of surface coatings has historically been used. This can be avoided by using **Media Blasting Technology**. Many types of blasting media are available for paint stripping. The most common type is plastic, but wheat starch or dry ice can be used as well. The greatest advantage of media blasting is that it does not produce wastewater. However, spent media containing paint chips may have to be disposed of as hazardous waste. Fortunately, some plastic media are recyclable.

Choosing an Appropriate Alternative

The first step in choosing an alternative, after a cleaning technology has been selected, is to decide what kind of detergent is best suited for the specific application it will be used for. Generally, testing of different products will be necessary to make a final decision on the exact type of cleaner to be used. But before starting any testing, a pre-selection is recommended. To do so, the person responsible for the selection should evaluate all the information provided by different manufactures and more specifically through the Material Safety Data Sheets (MSDS).

It should be remembered that the choice of an environmentally friendly detergent depends greatly on the type of cleaning technology used, the parts to be cleaned and the contaminant to be removed.

Conclusion

A large variety of environmentally friendly alternatives to conventional cleaning and degreasing methods is available in the market place. The choice of a specific alternative will be mainly determined by the budget available, the type of operation to be replaced, the parts to be cleaned and the contaminant to be removed. In any Pollution Prevention Program, cleaning and degreasing operations should be investigated and environmentally friendly alternatives implemented to replace the use of harmful solvents.

For More Information, Contact:

Division of Solid & Hazardous Waste - (801) 538-6170
Pollution Prevention Coordinator - (801) 536-4477
Environmental Hotline - 1 (800) 458-0145
Small Business Assistance Program - (801) 536-4479